# WATER MAIN

# DESIGN AND CONSTRUCTION STANDARDS

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**TOWN OF HERNDON, VIRGINIA**
**DEPARTMENT OF PUBLIC WORKS**
**P.O. BOX 427**
**777 LYNN STREET**
**HERNDON, VIRGINIA 20172**

**Telephone 703-435-6853**

# TABLE OF CONTENTS

**SECTION 3.0 TECHNICAL SPECIFICATIONS**



**SECTION 4.0 STANDARD DETAILS**

# SECTION 1.0 GENERAL INFORMATION

## 1.01 Purpose

The purpose of the Water Main Design and Construction Standards is to identify the minimum standard criteria to be followed by the Public, Designers, Design Engineers, Developers, and Contractors when preparing plans/specifications for the water system or for construction of water system facilities in the Town of Herndon (the Town). All water main extensions become the property of the Town upon completion of installation and acceptance.

This Standard covers the minimum criteria for water system facility design criteria, material and construction requirements, and compliance with the requirements of the Virginia Department of Health, Office of Water Programs, Waterworks Regulations. This standard does not purport to cover all possible circumstances. The Town of Herndon retains the right to modify these requirements as deemed necessary to protect the water distribution system**.** It is the responsibility of those performing work within the Town of Herndon to comply with all local, state and federal regulatory authorities. Where a conflict exists between these standards and the regulatory requirements, the more restrictive requirements shall apply.

It is the policy of the Town of Herndon, Department of Public Works to avoid and protect environmentally sensitive areas wherever possible including wetlands, historical/archaeological sites, and other designated protected areas.

# SECTION 2.0 DESIGN STANDARDS

## 2.01 Water Demand Projections

In determining domestic water demand for future development, the following conversion factors are applied to convert dwelling units into equivalent persons per dwelling unit:

| Type of Dwelling Unit | Persons/Dwelling Unit |
|---|---|
| Single Family | 3.57 |
| Duplex | 3.22 |
| Multiplex | 2.42 |
| Mobile Home | 2.61 |
| Garden Apartment | 2.50 |
| Elevator Apartment | 1.50 |

The average daily water consumption rates for planning purposes shall be in accordance with the Virginia Department of Health, Waterworks Regulations, as follows:

| Service | Gallons Per Day |
|---|---|
| Dwellings, per person | 100 |
| High Schools with Showers, per person | 16 |
| Elementary Schools without showers, per person | 10 |
| Boarding Schools, per person | 75 |
| Motels at 65 gallons per person, minimum per room | 130 |
| Restaurants, per seat | 50 |
| Factories, per person, per eight-hour shift | 15-35 |
| Shopping Centers, per 1,000 sq. ft. of ultimate floor space | 200-300 |
| Hospitals, per bed | 300 |
| Nursing Homes, per bed | 200 |
| Home for the Aged, per bed | 100 |
| Doctor's Office in Medical Center | 500 |
| Laundromats, 9 to 12 machines, per machine | 500 |
| Community Colleges, per student and faculty member | 15 |
| Swimming Pools, per swimmer | 10 |
| Theaters, Auditorium Type, per seat | 5 |
| Picnic areas, per person | 5 |

Any such rates not given or any deviations from tabulated rates shall be estimated and justified by the Design Engineer and approved by the Town of Herndon.

The average daily water consumption rate is converted to peak water demands by using the following applicable factors:

| Peak Event | Peaking Factor |
|---|---|
| Maximum Daily | 1.6 (x Average Day) |
| Peak Hourly | 1.6 (x Maximum Day) |

Water Supply facilities are designed to accommodate the maximum daily demand and the distribution system is designed for the peak hourly demand. Storage facilities are designed to augment the water supply facilities during the peak hourly event.

## 2.02 Pressure Requirements

The water distribution system, and any extensions thereof, shall have adequate capacity to supply the average and maximum daily and peak hourly demands for all customers - domestic, public, commercial and industrial, while maintaining the following minimum pressure at points of delivery:

40 psi for maximum daily flow
30 psi for peak hourly flow
20 psi for maximum daily + fire flow

The system shall be capable of meeting the maximum daily demand plus fire flow demand as specified by the Fairfax County Office of the Fire Marshal. In areas where the distribution system will not be able to meet the maximum daily and peak hourly flow pressure standards, the property owner will be required to furnish the necessary on-site system to obtain required service pressure. The above 20 psi standard for maximum daily demand plus fire flow is required under all circumstances.

When the service connection for the property owner is located where the water pressure will exceed 80 psi, a pressure regulating valve shall be furnished and installed by the property owner and located in the building plumbing system in order to eliminate water hammer and decrease water consumption. System restrictions and topography may, in some cases, require a variation in the pressures identified herein. Any deviation from the requirements herein shall require approval by the Town of Herndon.

## 2.03 Fire Flow Requirements

Rates of flow for fire protection shall be as specified by the Fairfax County Office of the Fire Marshal. A maximum allowance of 50% reduction in needed fire flow may be allowed for buildings with automatic sprinkler systems that provide full protection.

The minimum fire flow from any individual fire hydrant shall be 500 gpm. The minimum flowing pressure at maximum flow shall be 20 psi.

## 2.04 Hydraulic Criteria

The installation of new system extensions within the Town of Herndon's distribution system must be analyzed to determine the proposed performance. The applicant shall determine the quantity of water required and the point of connection. The Engineer shall determine the hydraulic gradient available at the point of connection to the system while providing said demands. The distribution piping design by the applicant must be based upon provided capacities and service pressures in accordance with these standards for the supply gradient as determined by the Engineer.

## 2.05 Velocity

The maximum velocity to be used for piping shall be 7 fps. All mains, branches and dead ends shall be equipped with blowoffs and/or hydrants of adequate size and number to develop a velocity in the main of at least 2.5 feet per second. The Design Engineer shall consider minimum velocities in pipe sizing to avoid water quality concerns.

## 2.06 Pipe Friction

The Hazen-Williams formula will be used in the determination of friction loss for all piping. The Hydraulic Institute Standards shall be used for pumping systems and for headloss attributed to pipe, fittings and other miscellaneous appurtenances. Where the Hydraulic Institute Standards do not apply, the headloss for these items shall be in accordance with the manufacturers certified test data for the item.

C-values for all concrete lined ductile iron pipe shall be in accordance with the following:

| Pipe Diameter (Inches) | C-Value |
|---|---|
| 6 | 100 |
| 8 | 110 |
| 10 | 115 |
| 12 and larger | 120 |

## 2.07 Minimum Pipe Size

The minimum size of public water line shall be 6-inches in size. The minimum size water line used for fire protection to properties zoned multi-family residential, commercial, or industrial shall be 8-inches in size. These fire service lines shall be looped to provide feed from at least two directions.

## 2.08 System Design

The proposed system extension, together with the pertinent existing system components, shall be evaluated based on the hydraulic design, demand design, and fire protection design requirements contained heretofore. The Design Engineer shall submit to the Town a neat and orderly set of signed and sealed design calculations to illustrate normal demands and fire flows, pipe size selection, and fire protection requirements. The Design Engineer shall submit a written request to the Town to review and approve the proposed system design.

Insofar as practicable, distribution systems shall be compatible with the Town's plan for an integrated water system. The number of dead end lines shall be minimized by looping mains. All dead end mains over five (5) feet in length and not terminating with a hydrant shall have adequate blowoff valves at the ends thereof. Dead end lines shall not exceed 500 feet in length. Not more than one fire hydrant shall be installed on a 6-inch dead end line, with the fire hydrant located within the first 300 feet of the line. No flushing device shall be directly connected to any sewer.

Water mains 16-inch I.D. and larger shall not be tapped for individual services. Automatic combination air-vacuum release valves shall be installed at the high points of water mains 16-inch I.D. and larger, where accumulation of air may interfere with flow. Blowoffs will be required at low points of lines 16-inch I.D. and larger. Air-vacuum release valves and blowoffs will be installed in all other main sizes as required.

Valves shall be installed at appropriate points in all mains to permit shutting off water from as small a portion of the system as practicable. A minimum of two valves shall be provided at tee fittings (except fire hydrant tees), three valves at cross fittings. The supply branch serving a hydrant shall include a valve.

## 2.09 Submission Requirements

Design drawings shall contain as a minimum the following information:

(a) Professional Engineer seal and signature.
(b) Vicinity map.
(c) North Arrow (each plan view).

(d) Scale (all applicable sheets).
(e) Reference to all applicable Standard Notes and Details.
(f) Plan and profile of all proposed water mains, with complete and consistent stationing (all views).
(g) Show all existing water and sanitary sewer easements within and immediately adjacent to proposed limits of construction.
(h) Inverts and slopes of sanitary sewer which are within or immediately adjacent to proposed limits of construction.
(i) Show water service lines to each proposed structure/lot.
(j) Label all water main fittings, valves and appurtenances, plan and profile.
(k) Show all crossing storm sewer and other utilities accurately on profiles of water mains.
(l) Provide and label match lines for sheet to sheet continuations.
(m) Benchmarks and a minimum of four grid tics based on state plane or coordinate system compatible with the Town's GIS system.

## 2.10 Materials

(a) All water system related materials, including pipe, fittings and valves, shall comply with Section 3.0 Technical Specifications. All materials not currently covered by these Standards shall be in accordance with the applicable American Water Works Association (AWWA) Standards or other recognized Standards acceptable to the Town. These materials shall be formally submitted to the Town with appropriate product specifications for approval.

(b) Water mains shall be ductile iron pipe (DIP) only. Polyvinyl chloride (PVC) and all other water line piping materials are not acceptable.

## 2.11 Separation of Water Mains and Sanitary Sewers

(a) General: The following factors shall be considered in providing adequate separation:

(1) Materials and types of joints for water and sewer pipes.

(2) Soil conditions.

(3) Service branch connections into the waterline and sewer lines.

(4) Compensating variations in the horizontal and vertical separations.

(5) Space for repairs and alterations of water and sewer pipes.

(6) Offsetting of pipes around manholes.

(b) Parallel Installation:

(1) Normal Conditions - Waterlines shall be laid at least ten (10) feet horizontally from a sewer or sewer manhole whenever possible. The distance shall be measured edge-to-edge.

(2) Unusual Conditions - When local conditions prevent a horizontal separation of ten (10) feet, the waterline may be laid closer to a sewer provided that:

(A) The bottom of the waterline is at least 18 inches above the top of the sewer.

(B) Where this vertical separation cannot be obtained, the sewer shall be constructed of AWWA approved water pipe and pressure tested in place to 50 psi without leakage prior to backfilling.

(c) Crossing:

(1) Normal Conditions - Waterlines crossing sewers shall be laid to provide a separation of at least 18 inches between the bottom of the waterline and the top of the sewer whenever possible.

(2) Unusual Conditions - When local conditions prevent a vertical separation described above, the following construction shall be used:

(A) Sewers passing over or under waterline shall be constructed of AWWA approved water pipe and pressure tested in place to 50 psi for leakage prior to backfilling.

(B) Waterlines passing under sewers shall, in addition, be protected by providing:

(i) A vertical separation of at least 18 inches between the bottom of the sewer and the top of the waterlines.

(ii) Adequate structural support for the sewers to prevent excessive deflection of the joints and settling on or breaking waterline.

(iii) The length of the waterline shall be centered at the point of the crossing, such that the joints are equidistant and as far as possible from the sewer.

(d) Sanitary Sewers and Sewer Manholes: No potable water pipes shall pass through or come in contact with any part of a sewer or sewer manhole.

## 2.12 Valve, Air Relief, Meters and Blow Off Chamber

Chamber or pits containing valves, blowoffs, meters or such appurtenances to a distribution system shall not be connected to any storm drain or sanitary sewer, nor shall blowoffs or air relief valves be connected directly to any sewer. Such chambers or pits shall be drained to the surface of the ground where they are not subject to flooding by surface water, or to absorption pits underground. Sump pumps may be used where other gravity drains are not practical. The open end of an air relief pipe should be extended from the manhole or enclosing chamber to a point at least one foot above ground and provided with a screened, downward-facing elbow.

## 2.13 Hydrants

(a) Fire hydrants shall be located in accordance with the most current edition of the Fairfax County Public Facilities Manual (PFM).

(b) Fire hydrants shall be placed on legal rights-of-way and shall generally be placed in line with street intersections. Where long block lengths require the use of intermediate fire hydrants, they shall be placed in line with the property boundary between adjacent lots or parcels of land. Where fire hydrants cannot be placed in a legal right-of-way, an easement shall be provided.

(c) Fire hydrant spacing criteria may be modified by the Town of Herndon to improve accessibility for fire fighting purposes.

(d) Structures protected by automatic sprinkler systems and with a fire department connection (Siamese connection) require installation of a detector check, dedicated fire hydrant, and the appropriate backflow device. The dedicated hydrant is not credited toward external protection requirements. Siamese connections must be located within 50 feet of a dedicated hydrant.

(e) Fire hydrants shall have drains to dry wells or sumps provided exclusively for this purpose. Hydrant drains shall not be connected to sanitary sewers or storm drains.

(f) Where directed by the Town, fire hydrants shall be strapped to valves.

## 2.14 Water Service and Plumbing Connections

(a) Water services and plumbing connections shall conform to relevant and the latest revision of local and/or State Plumbing Code.

(b) Water service lines shall be a minimum of 1-inch diameter. All service lines 1-inch through 2-inches in diameter shall be constructed of type "K" copper tubing and shall be constructed with a corporation stop, meter yoke and meter-box. Water service lines larger than 2-inches will utilize a gate valve on the service line mounted near the water main in lieu of the corporation stop.

(c) Service lines will have a minimum cover of thirty-six inches from the top of the pipe to finished grade at all points, including the ditch line.

(d) Water service lines shall be placed at the midpoint of the property frontage whenever possible. The meter-boxes shall be set in the utility strip for curb and gutter streets. For streets without curb and gutter, meter-box placement will be directed by the Town of Herndon.

## 2.15 Pipeline Cover

Minimum pipeline cover over the top of pipe and valves shall be equal to or not less than four (4) feet. In order to cross above a sewer rather than below, the normal cover at this crossing can be reduced to three (3) feet. The maximum normal cover allowed is 7.5 feet. In situations where the cover exceeds 7.5 feet, alternative water main routes must be investigated in an attempt to avoid excessive cover.

## 2.16 Metering

(a) All service lines shall be metered. Meter installation shall be in accordance with the Standard Details.

(b) Remote meter reading equipment: Section Intentionally Left Blank.

(c) All meters, including submeters, shall be provided with backflow prevention.

(d) Service lines larger than 3/4 inch, with meters larger than 5/8 inch, shall be sized in accordance with AWWA Manual M-22, Sizing Water Service Lines and Meters, except as follows:

(1) Use constant pressure factor of 1.

(2) Include all outside hose bibs in combined fixture value total.

(3) Irrigation System shall be excluded from domestic meter sizing criteria except as follows:

(A) Exclusion meters shall be at least one (1) size smaller than the domestic meter.

(B) If metered separately, the irrigation meter shall be sized based on demand criteria furnished by the Engineer.

(4) For non-residential facilities with flush-valve fixtures, the meter will be sized as follows:

| Meter Size (Inches) | Combined Fixture Value Total |
|---|---|
| 1" | 41-100 |
| 1½" | 101-400 |
| 2" | 401-1200 |

(5) For residential facilities and office buildings with tank type water closets the meter will be sized as follows:

| Meter Size (Inches) | Combined Fixture Value Total |
|---|---|
| 5/8" | 0-40 |
| 1" | 41-400 |
| 1½" | 401-5500 |

(6) Plumbing Fixtures Values shall be as shown in AWWA No. M-22 for 35 psi.

(7) Meter installations requiring a flow of greater than 160 gpm or greater than the combined fixture value totals indicated above shall be reviewed and/or approved on a case by case basis in accordance with AWWA Manual No. M-22.

(8) A 5/8" meter may be used for non-residential facilities with tank type water closets and a 0-40 total combined fixture value. A 1" meter will be the minimum size used for any facility with flush valve fixtures.

## 2.17 Corrosion Control

Cathodic protection shall be required when a water main crosses or is in close proximity to a pipeline which has an impressed electrical current, such as petroleum or high pressure gas transmission mains. Necessary corrosion control measures shall be determined on a case by case basis, with the protection measures to be designed by a qualified profession engineer.

## 2.18 Backflow Prevention and Cross Connection Control

All water distribution facilities and operations shall comply with Part II, Article 3: Cross Connection Control and Backflow Prevention in Waterworks of the Waterworks Regulations of the Virginia Department of Health. All water distribution facilities and operations shall also comply with any applicable current programs for cross connection control and backflow prevention by the Town of Herndon.

## 2.19 Easements

(a) Easements shall be in accordance with the Town of Herndon Site Plan Review and Subdivision Plan Construction Process. Coordinate with the Department of Community Development regarding all requirements.

## 2.20 As-Builts

During construction, the contractor shall maintain a record of the location, depth and orientation of the water utility as it is installed. These updated records shall be documented electronically in as-built drawings. The drawings shall be in Auto CADD version 14 or newer and shall utilize a CADD drawing layering standard comparable to the current AIA standard. The survey work and drawings shall be performed in the 1983 North American Datum (NAD 83). All drawings shall be conveyed to the Town for review and approval. The Contractor shall submit for review a minimum of two (2) paper copies of the complete As-Built construction plan sets, including all sheets. The location and identification of all existing underground utilities encountered during construction shall also be identified. Upon approval of the As-Builts by the Town of Herndon, the Contractor shall forward two (2) final paper copies and the digital file on CD-ROM.

# SECTION 3.0 TECHNICAL SPECIFICATIONS

# SECTION 4.0 STANDARD DETAILS

# SECTION 5.0 APPENDICES